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14. ABSTRACT

The Workshop on Image Processing Applications for the Digital Battlefield was held at Clark Atlanta University, September 14-15, 1998. The workshop focused on the area of image processing applications as applied to the needs of the military.

Presentations during the workshop covered topics in image and video compression, image analysis for automatic target detection/recognition, motion analysis, and target tracking. The speakers included distinguished representatives from academic, industry, and military sponsors.

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REPORT ON

THE WORKSHOP ON IMAGE PROCESSING APPLICATIONS FOR THE DIGITAL BATTLEFIELD

Clark Atlanta University
Atlanta, Georgia
September 14 -15, 1998

Dr. Romain Murenzi

REPORT ON

THE WORKSHOP ON IMAGE PROCESSING APPLICATIONS FOR THE DIGITAL BATTLEFIELD

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The Workshop On Image Processing Applications For The Digital Battlefield was held at Clark Atlanta University, September 14 -15, 1998. The workshop focused on the area of image processing applications as applied to the needs of the military.

Presentations during the workshop covered topics in image and video compression, image analysis for automatic targer detection/recognition, motion analysis, and target tracking. The talks focused on how the state of art in image processing can advance the capabilities of the armed forces for the next century. The speakers included distinguished representatives from academic, industry, and military sponsors. The military sponsors discussed the vision for the future and the role in which image processing is expected to support this vision.

Registration was open to all interested persons in advance and also on the day of the Workshop. The workshop registration gee was $75.00. The student discounted fee was $25.00. The fee entitled the participant to all coffee breaks, meals (continental breakfast, lunch, reception and dinner), the Book of Abstracts, and souvenirs.

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- Lt. Col. Steven C. Suddarth, Air War College
  "How Image Processing contributes to the future vision of BMDO and the Air Force"

- Ms. Carol Williams, Ballistic Missile Defense Office

REGISTRATION

WORKSHOP ON IMAGE PROCESSING APPLICATIONS FOR THE DIGITAL BATTLEFIELD

September 14 - 15, 1998

Clark Atlanta University
Research Center for Science & Technology
Atlanta, Georgia

Registration Form

Please complete registration form on-line. Print and mail form with your registration fees.

Name (As to appear on Badge):

Position/Title:

Institution/Organization:

Address:

City:

State:

Zip Code:

Telephone:

Fax:

Email:

Check box if registering as a student ☐

FEES:
Registration will be open to all interested persons in advance and also on site. The conference registration fee is $75.00. The student discounted fee is $25.00. The fee entitles the participant to all coffee breaks, meals (continental breakfast, lunch, reception and dinner), the Book of Conference Abstracts, and souvenirs.

Please make check payable to: **Clark Atlanta University / Center for Theoretical Studies of Physical Systems** and mail to:

Ms. Katrina Barnum, Conference Coordinator
Clark Atlanta University
Center for Theoretical Studies of Physical Systems
223 J.P. Brawley Drive, S.W.
Atlanta, Georgia 30314
email: kbarnum@pegasus.cau.edu
fax: (404) 880-8360

WORKSHOP PROGRAM

WORKSHOP ON IMAGE PROCESSING APPLICATIONS FOR THE DIGITAL BATTLEFIELD

Clark Atlanta University
Research Center for Science & Technology
Auditorium
Atlanta, Georgia

Monday, September 14 (Day One)

7:30 - 8:30 **Registration and Breakfast** (Room 1047C)

8:30 - 9:00 **Introduction**
Dr. Romain Murenzi (CAU)
Dr. Alfred Msezane, Director, CTSPS (CAU)
Dr. Kofi Bota, V.P. for Research & Sponsored Programs (CAU)

9:00 - 10:30 **Grand Vision**
Chairman, Dr. Mark Smith (GA Tech)

- Mr. John Miller, Army Research Laboratory (ARL)
  "Sensor Technology for the Army After Next."
- Mr. Mike Hess, Office of Naval Research Laboratory (ONRL)
  "US Navy Target Identification Vision"
- Mr. Roger Cranos, Air Force
  "Air Force Target Identification Vision"

10:30 - 10:45 **Break** (Room 1047C)

10:45 - 11:45 **Programs I**
Chairman, Dr. Marvin Cohen (GA Tech)

- Mr. Steve Welby, DARPA
  "The DARPA Sensor Exploitation Vision"
- Dr. Robert Hummel, DARPA
  "The MSTAR model-based automatic target recognition system"

11:45 - 13:00 **Lunch** (Exhibition Hall, 2nd Floor)

13:00 - 15:00 **Programs II:**
Chairman, Major Steve Suddarth (BMDO)

- Mr. Denis Andersh, RTMI
  "The XPATCH prediction tool and its utilization in ATR/NCTI development"

- Mr. David Rodkey, Army Research Laboratory
  "TESAR Automatic Target Recognition (ATR)"

15:00 - 15:30 **Break** (Room 1047C)

15:30 - 18:00 **Research Presentations I:**
Chairman, Mr. John. Miller (ARL)

- Mr. Jim McClellan, Georgia Tech

- Dr. Rama Chellapa, University of Maryland
  "Video Processing for Battlefield Awareness"

- Dr. Leslie Novak, MIT Lincoln Laboratories
  "Updates on ATR template-based techniques"

- Dr. John Gorman, Environmental Research Institute of Michigan (ERIM)
  "Compression and Exploitation of Coherent SAR Data"

- Dr. David Casasent (ATR), Carnegie Mellon University
  "Filters and Neural Nets for SAR ATR"

18:00 - 19:00 **Reception** (Exhibition Hall, 2nd Floor)

19:00 - 20:30 **Dinner** (Exhibition Hall, 2nd Floor)

WORKSHOP ON IMAGE PROCESSING APPLICATIONS FOR THE DIGITAL BATTLEFIELD

Clark Atlanta University
Research Center for Science & Technology
Auditorium
Atlanta, Georgia

Wednesday, September 15 (Day Two)

8:00 - 8:30 **Continental Breakfast** (Room 1047C)

8:30 - 10:30 **Research Presentations II:**
Chairman, Dr. Leslie Novak (MIT Lincoln Laboratory)

- Dr. Basilis Gidas, Brown University
  "Object Tracking in Cluttered Enviroments via Monte Carlo Filtering"
- Mr. Ed Zelnio, Wright Laboratory
  "ATR technology status or a general model-based ATR overview / status"
- Dr. Joseph O'Sullivan, CIS, Washington University
  "CIS Vision Military Applications of Image Processing"
- Dr. Firooz Sadjadi, Lockeed Martin Tactical Defense Systems
  "Image Based Target Classification- Another Perspective"

10:30 - 10:45 **Break** (Room 1047C)

10:45 - 12:15 **CAU Research Presentations**

- Dr. Romain Murenzi/Dr. Kameswara Namuduri
  Physics Department
- Dr. Olitadoye, Engineering Department
- Dr. Lance Kaplan, Engineering Department
- Dr. Kenneth Perry, Computer Science Department

12:15 - 13:30 **Lunch** (Exhibition Hall, 2nd Floor)

13:30 - 15:00 **Funding Opportunities**

- Dr. J. Chandra, Army Research Laboratory.
  "Nonlinear Dynamical Approaches for Information and Image Processing"

- Lt. Col. Steven C. Suddarth, Air War College
  "How Image Processing Contributes to the Future Vision of BMDO and the Air Force"

- Ms. Carol Williams, Ballistic Missile Defense Office

- Mr. David Rodkey, Army Research Laboratory

15:00 - 16:00 **General Discussion and Wrap Up**

TRAVEL & ACCOMMODATIONS

Travel & Accommodations

TRAVEL

The City of Atlanta is serviced by the Atlanta Hartsfield International Airport. The airport is approximately 10 miles south of downtown Atlanta off Interstate I-85. There are three major highways serving the airport (I-285 -- runs east-west and is south of the airport; I-75 runs north and south of the airport and is east of the airport and I-85 which also runs north and south of the airport and is west of the airport).

The Airport is clearly signposted from all directions.

Air Transportation

Make your reservation to fly into Atlanta via The Atlanta Hartsfield International Airport. The airport is serviced by all major airlines. Atlanta is the hub for Delta Air Lines.

Ground Transportation

Car Rental

The following are car rental agencies that service the Atlanta Hartsfield International Airport:

1. Alamo	800-327-9633
2. Avis	800-331-1212
3. Budget	800-527-0700
4. Dollar	800-800-4000
5. Enterprise	800-325-8007
6. Hertz	800-654-3131
7. National	800-227-7368
8. Payless	800-729-5377
9. Thrifty	800-367-2277
10. Value	800-GO VALUE

The car rental companies have desks in the Airport Terminal's central Arrivals area located between the baggage claim areas.

They provide a frequent shuttle service to the car rental lots from the transportation area outside the terminal.

Taxi / Shuttle / Limos

A number of companies operate bus and van service to and from the airport.

1. **Atlanta Airport Shuttle**
   services Downtown and Atlanta Airport every 15 minutes
   $8.00 one way; $14.00 round trip
   Details: 800-842-2770; 404-524-3400

2. **ShuttleTran**
   Provide service from metro Atlanta
   Details and reservation: 800-556-5466

3. **Yellow Cab Company**
   Details: 770-452-0006

4. **Checker Cab**
   Details: 404-351-1111

5. **Atlanta Cab Company**
   Details: 404-521-0200

6. **Airport Connection**
   Provides regular service from Atlanta area hotels.
   Details: 770-457-5757

7. **Carey Limousine**
   Details and reservation: 404-223-2000

Local Transportation
The Atlanta Metropolitan area bus service is provided by MARTA (Metropolitan Atlanta Rapid Transit Authority) http://www.itsmarta.com/index.html. The transit system provides bus and rail service to patrons in Fulton, Dekalb counties.

There is a MARTA rail station conveniently located is accessible at the Atlanta Airport. It is located right at the terminal building and is a two minute walk to both Terminals North and South.

The MARTA rail station closest to Clark Atlanta University is the West End rail station. It is appx. 10 minutes walking distance from the University. Shuttle service will be available from the West End rail station on both Workshop days. The shuttle schedules are forthcoming.

The MARTA station is also minutes from each hotel (listed under accommodations). Airport and Peachtree Center Station--downtown. See front desk clerk at your respective hotels for travel to and from the rail stations.

The single ride cash fare for MARTA is $1.50 (exact change please).
Roll of tokens can be purchased at the Ride Stores located Five Points Station or Airport Station in denomination of 10 - $15.00 or 20 - $25.00

Individual tokens are for sale at token machines located directly outside the faregates at all rail stations.

Buses
Most buses runs from 5 a.m. to 1:30 a.m. Monday through Friday and 5:30 a.m. to 12:30 a.m. weekends and Holidays. Times vary on individual routes.

Rail Service
MARTA's rail system operates from 5 a.m. to 1:00 a.m. Monday through Friday and from 6:00 a.m. to 12:30 a.m. weekends and holidays. Rail cars run every 8-10 minutes on weekdays and every 10-15 minutes on Saturdays and every 15 minutes on Sundays and holidays.

Contact the Customer Information Line at (404) 848-4711 for specific times of bus/rail departures and arrivals.

ACCOMMODATIONS

Blocks of rooms have been reserved for attendees of the Workshop at the hotels listed below. Please make your reservation directly with any one of the hotels (DO NOT REGISTER ONLINE). Mention you are attending the **Workshop on Image Processing at Clark Atlanta University** in order to receive the discounted room rate.

The Courtyard by Marriott (Downtown Atlanta)
175 Piedmont Avenue, N.E.
Atlanta, Georgia 30303
(404) 659-2727 or
http://www.courtyard.com/courtyard/ATLCD/
$85.00 per night -- single, double, trip or quad Occupancy
The rate is subject to taxes currently at 14%.
DEADLINE FOR RESERVATION: Thursday, September 3, 1998

The Fairfield Inn by Marriott (Downtown Atlanta)
175 Piedmont Avenue, N.E.
Atlanta, Georgia 30303
(404) 659-7777
http://www.fairfieldinn.com/fairfieldinn/ATLFD/

$74.00 per night -- single, double, triple or quad Occupancy
The rate is subject to taxes currently at 14%.
(The rate does include complimentary continental breakfast)
DEADLINE FOR RESERVATION: Thursday, September 3, 1998

The Club Hotel by DoubleTree (Atlanta Airport North) -- Brand New
3400 Norman Berry Drive
Atlanta, Georgia 30344
(404) 763-1600
(888) 444-2582 (toll free)
http://www.clubhotels.com
$79.00 per night - single/double Occupancy--$10 each additional person
DEADLINE FOR RESERVATION: Monday, September 7, 1998
(offers free shuttle service to and from airport -- 24 hours/day).

Clark Atlanta University will provide free shuttle service for all workshop attendees/speakers to and from the University, hotels and MARTA stations. Please contact Ms. Katrina Barnum, kbarnum@pegasus.cau.edu to obtain the shuttle schedule.

ORGANIZING COMMITTEES

Organizing Committees

The hosting institution for the Workshop on Image Processing Applications for the Digital Battlefield is Clark Atlanta University, Center for Theoretical Studies of Physical Systems.

Dr. Alfred Z. Msezane, Director
Dr. Carlos R. Handy, Co-Director
Ms. Katrina L. Barnum, Administrative Assistant
Mr. Lloyd Humphrey, Administrative Assistant

Internal Organizing Committee
Dr. Romain Murenzi
Dr. Lance Kaplan
Dr. Kameswara Namuduri
Dr. Mark Smith
Dr. Marvin Cohen

Please contact Ms. Katrina Barnum *kbarnum@pegasus.cau.edu*, (404) 880-6700 / (404) 880-8633 for assistance in conference information.

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WORKSHOP SPONSORS

Workshop Sponsors

The Ballistic Missile Defense Office (BMDO) and the United States Air Force are the official sponsors of the Workshop on Image Processing Applications for the Digital Battlefield.

ABSTRACTS

Xpatch Prediction Codes Utilized for ATR/NCTI Applications

Dennis. J. Andersh
Vice President
DEMACO, Inc.
dandersh@demaco.com

Abstract

This presentation describes the Xpatch electromagnetic computer prediction code for generating radar cross section (RCS), time-domain signatures and synthetic aperture radar (SAR) images of realistic 3-D vehicles for multiple automatic target recognition (ATR) applications. The code has been used for aircraft, ground vehicles and missiles that are represented by a computer-aided design (CAD) file with triangular facets, IGES curved surfaces (NURBS or B-Splines), or solid geometries. Xpatch is based on the shooting-and-bouncing-ray-technique, and is used to calculate the polarimetric radar return from the vehicles represented by these different CAD files. Xpatch computes the first-bounce Physical Optics plus the Physical Theory of Diffraction contributions. Xpatch calculates the multi-bounce ray contributions by using geometric optics and physical optics for complex vehicles with materials. It has been found that the multi-bounce contributions are crucial for many aspect angles of all classes of vehicles. Without the multi-bounce calculations, the radar return is typically 10 to 15 dB too low. Examples of predicted range profiles, SAR imagery, and radar cross sections (RCS) for several different geometries are compared with measured data to demonstrate the quality of the predictions. Recent enhancements to Xpatch include improvements for MMW applications and hybridization with Finite Element Methods for small geometric features and augmentation of additional IGES entities to support trimmed and untrimmed surfaces.

Keywords: Xpatch, radar scattering, automatic target recognition, computer-aided design, shooting-and-bouncing-rays

BIO

Dennis J. Andersh
DEMACO, Inc.

M.S.E.E, 1991
AFIT
B.S.E.E.
University of Arizona, 1980

Mr. Dennis Andersh has over 22 years experience in DoD radar system development and operational fielding and usage and is a Member of the IEEE AP Society. Prior to joining DEMACO in January 1996, he was involved in leading and directing electromagnetic research and development in the USAF for ground, air and space applications. Mr. Andersh received the USAF Research and Development Award in 1994 for his work in asymptotic computational electromagnetics research and development. Mr. Andersh is now a Senior Engineer for DEMACO, Inc., responsible for high fidelity SAR scene modeling, multi-spectral target signature simulations and ATR development for DoD and commercial applications.

Filters and Neural Nets for SAR ATR

Professor David Casasent
Carnegie Mellon University
Pittsburgh, Pennsylvania
casasent@gauss.ece.cmu.edu

Abstract

SAR sensors represent all-weather, day and night high resolution sensors. However, they also present new challenges for target detection and recognition. For distortion-invariant detection with reduced clutter false alarms, distortion invariant filters are very attractive. For classification, neural networks have shown promising results. New Minace, eigen detection, and eigen-Minace filter results and new neural net results will be presented. FOPEN test results will be noted if time permits.

BRIEF BIO

Professor David Casasent is a Full Professor at Carnegie Mellon University, Pittsburgh, Pennsylvania, in the Department of Electrical and Computer Engineering, where he is the George Westinghouse Professor and Director of the Laboratory for Optical Data Processing. He is a Fellow of the IEEE, OSA and SPIE and has received various best paper awards and other honors. He is the author of two books, editor of one text, editor of 50 journal and conference volumes, contributor to chapters in 20 books and over 600 technical publications, on various aspects of optical data processing, image pattern recognition, and real-time signal processing.

Dr. Casasent is active in conference organizations and is a consultant to companies and government agencies. He originated and has organized the set of 6 to 11 annual SPIE conferences on Intelligent Robots and Computer Vision. He has chaired the Intelligent Robots and Computer Vision conference for 15 years. He has also chaired and organized the Optical Pattern Recognition and Hybrid Image and Signal Processing SPIE conferences for 7 years. He is Past President of SPIE and was on the Board of Directors of SPIE for 6 years. He received the 1996 SPIE President's Award. He is a past member of two Defense Science Board Task Forces (on Image Recognition and on Automatic Target Recognition). He is past President of the Pittsburgh chapters of the IEEE-ED and the Optical Society of America. He is presently Faculty Advisor to Eta Kappa Nu among other such activities. His research interests include: distortion-invariant pattern recognition, neural networks, Gabor and wavelet transforms, robotics, morphological image processing, and product inspection. He was on the Board of Directors of INNS (the International Neural Network Society) from 1994-1996 and was General Chair of the 1996 INNS conference. He has chaired and organized Pattern Recognition sessions at INNS conferences for over 5 years. He is President Elect of INNS. He is presently on the Board of Directors of Europto, and is an Editorial Board member of Neural Networks, Neurocomputing, plus six other journals.

Nonlinear Dynamically Approaches for Information and Image Processing

Jagdish Chandra
US Army Research Laboratory
jchandra@mail.arl.mil

Abstract

Explore potential of spatial temporal dynamics to a variety of applications including motion analysis and target tracking.

BIO

Dr. Jagdish Chandra serves as the Deputy Director of Information Science and Technology Directorate and the Director of Atmospheric Research at the U.S. Army Research Laboratory. Until 1997, he served as the Director of Mathematical and Computer Sciences at the U.S. Army Research Office. Concurrently, he is an adjunct professor of Computer Sciences at the Johns Hopkins University. He is a senior member of IEEE, and member of the American Mathematical Society, the Society of Industrial and Applied Mathematics, and the Senior Executive Association. He serves on the editorial boards of the SIAM Review, and the International Journal on Nonlinear Analysis. Dr. Chandra received his Ph.D. in mathematical sciences in 1965 from the Rensselaer Polytechnic Institute. He has authored and co-authored more than forty publications in national and international journals in the fields of nonlinear analysis, systems and control theory, nonlinear dynamics, and reaction and diffusion system.

VIDEO PROCESSING FOR BATTLEFIELD AWARENESS

Rama Chellappa
Department of Electrical Engineering
Center for Automation Research
&
Institute for Advanced Computer Studies
University of Maryland, College Park
College Park, Maryland
chella@steinberg.umd.edu

Abstract

Monitoring the activities of vehicles and humans (combatants) is an important task for battlefield awareness. In this talk we address the role of video processing for activity monitoring. Specifically, we present algorithms for image stabilization, mosaicking, superresolution, detection and tracking of humans and vehicles. Results using PREDATOR data are presented.

BIO

Dr. Rama Chellappa is a Professor in the Department of Electrical Engineering and the Associate Director of Center for Automation Research, University of Maryland. College Park, MD. He has published numerous papers on surveillance, automatic target recognition in FLIR, HRR, LADAR, SAR and FOPEN imagery, statistical inference and image recognition. His scientific contributions have been recognized by several awards such as the NSF Presidential Young Investigator Award, the IBM Faculty Development Award, IEEE Fellow Award, International Association of Pattern recognition Fellow Award, and the Distinguished Faculty Research Fellow Award. He has also received an Excellence in Teaching Award in 1990. He has been the Principal Investigator of several DARPA ATR and Image Exploitation Programs, notably, RADIUS, Industry/University ATR, University ATR, and Image Exploitation. He has served as technical and general chairs of several national and international conferences and workshops. He has also served as an associate editor of several IEEE Transactions and edited a few research monographs and texts on Neural Networks, Markov Random Fields. He has supervised 28 Ph.D. dissertations and has served on several Government Panels, notably the DARPA MSTAR Architecture Panel and the ISAT Study Panel on Dynamic Databases.

Combat Identification in the Future: Maintaining the Balance

Mr. Roger Cranos
United States Air Force Research Laboratory
Wright-Patterson Air force Base
Ohio
rcranos@mbvlab.wpafb.af.mil

Abstract

A robust Combat Identification capability is vital to the warfighter. This presentation will discuss some of the issues and misconceptions surrounding CID, and how future CID technologies can overcome the limitations of today's CID systems and architectures. Virtually no capability, other than the human eye, exists for identifying ground targets, and a limited capability exists for air targets. To meet the warfighter's CID goals, the CID architecture of the future must include continued improvements in all CID technology areas. For off-board platforms, CID information can come from several sources including intelligence sources, national assets, and non-cooperative and cooperative CID systems installed on the off-board platform. Additionally, a fusion algorithm will assist in combining the various CID information before it is communicated to the shooting platforms. The shooter also utilizes a fusion algorithm to combine the off-board CID information with the onboard non-cooperative and cooperative CID systems. This resulting CID architecture enables warfighters to utilize all the information available to determine the identity of targets. Accurate and timely CID is the key to maximizing the warfighter's ability to accomplish the mission at hand.

Abbreviated Biography

Mr. Roger L Cranos is the Combat Identification Team Lead within the Reconnaissance, Strike and Combat Identification Branch, Sensor Applications and Demonstrations Division in the Sensors Directorate of the Air Force Research Laboratory. He has Bachelor and Masters degrees in Physics and has done advanced graduate work in Atmospheric Physics and Electromagnetics. For over thirty years Mr. Cranos has been developing avionics systems for the Air Force, initially as an Air Force Officer and later within Civil Service. He has extensive experience in the development of advanced electro-optical weapons systems and served as the Avionics Laboratory's Program Manager for the IR Maverick Development Program in the mid-70s. In the early-80s, he led a team in the development and transition of the first Tactical Decision Aids for the battlefield prediction of electro-optical weapon system performance. For the past ten years he has led a Wright Lab team developing advanced Combat Identification systems for transition to air-to-air and air-to-surface weapons platforms.

Automatic Target Recognition (ATR) Evaluation and Applications

Lynn E. Garn
U.S. Army CECOM RDEC Night Vision
and
Electronic Sensors Directorate
Fort Belvoir, VA
garn@nvl.army.mil

Abstract

This presentation describes Night Vision's efforts in evaluation of automatic target recognizer algorithms and hardware. Particular emphasis is given to the methodology for evaluating algorithm performance and the characterization of factors that influence performance. Preliminary efforts in characterization of clutter in infrared imagery are described. Finally a number of applications that will incorporate ATR are described.

Object Tracking in Cluttered Environments via Monte Carlo Filtering

Professor Basilis Gidas
Brown University
Division of Applied Mathematics
Providence, Rhode Island 02912
gidas@dam.brown.edu

Abstract

We will present a coherent framework for tracking moving objects in cluttered environments, on the basis of dynamically changing image sequences. The objects may be rigid or deformable. The procedure explores: (a) Lagrangian mechanics for describing the rigid and non-rigid dynamical motions of the objects, and (b) nonparametric statistics for designing observation models that relate the state space of the generalized Lagrangian coordinates with the grey-level image data. The combination of the two components leads to a non-linear filtering problem which is solved via a recently developed Monte Carlo filter. We will present experiments (including videos) with objects moving in environments with clutter, occlusions, and other degradation effects.

BRIEF BIO

****Basilis Gidas, Professor**
Division of Applied Mathematics, Brown University

Education:
*B.S. Electrical and Mechanical Engineering
National Technical University of Athens, Greece
*Ph.D. Nuclear Engineering and Physics
University of Michigan, Ann Arbor

Research Interests:
*Past Research Interests: Statistical Mechanics (Phase Transitions), Quantum Field Theories, Partial Differential Equations, Differential Geometry

*Current Interests: Computer Vision/Image Processing, Speech Recognition, Nonparametric Statistics, Complexity.

Compression and Exploitation of Coherent SAR Data

Dr. John Gorman
ERIM International
Ann Arbor, Michigan
gorman@csd5b.erim-int.com

Abstract

There are an increasing number of SAR data exploitation applications that require complex-valued data including interferometric SAR, including vibration detection, focusing of moving targets, super-resolution, coherent multiresolution target detection, attributed scatterer identification and coherent change detection. We briefly discuss the mathematical basis for several of these algorithms and the phenomenology behind the radar signature information that is being exploited. We then review recent work in the area of complex SAR data compression and look at algorithms that are currently being used for compressing both raw SAR phase history data and complex image data. Finally, we present some examples demonstrating the impact of complex data compression on exploitation and discuss some of the implications of using complex data compression in an operational setting.

BRIEF BIO

Dr. John D. Gorman is a Research Engineer with ERIM International in Ann Arbor, Michigan. He has thirteen years of experience in the area of image and signal processing applied to problems in remote sensing, including signature modeling and phenomenology, automatic target recognition, data compression and image formation. Dr. Gorman received the B.S. and M.S. degrees in Electrical Engineering from Washington University in St. Louis in 1983 and 1985, and the PhD in EE Systems from the University of Michigan in 1991.

ATR Research at CAU

Professor Lance Kaplan
Center for Theoretical Studies of Physical Systems
Department of Engineering
Clark Atlanta University
Atlanta, Georgia
lmkaplan@pioneer.cau.edu

Abstract

The state of the art Automatic Target Recognition (ATR) systems perform well in laboratory environments. However, these systems often do not exhibit enough robustness to work at a satisfactory level of performance in the field. Under the Federated Laboratory Consortium of the U.S. Army Research Laboratory, Clark Atlanta University (CAU) is working with a number of institutions to develop robust ATR systems that meet the requirements of the U.S. Army. The performance gains will be achieved through the fusion of imagery and other data collected by a different sensors such as FLIR, LADAR, SAR, and MMW radar. Under the Federated Laboratory, CAU has assisted in the development of various technologies to improve ATR. CAU continues to refine these methods for ATR and develop new methods. Examples of these technologies include: (1) features derived from the continuous wavelet transform (CWT) for target tracking, (2) CWT-based features for FLIR/LADAR ATR, (3) a fast SAR focus of attention method using contrast and extended fractal features, (4) alternative training methods for SAR ATR and (4) new image quality metrics to evaluate the suitability of compression algorithms used for the transmission of images in an ATR system. Moreover, the ARL Programming Environment and Training (PET) Program has provided CAU with the ability to incorporate high performance computing (HPC) to speed up development and training for its ATR technology.

BRIEF BIO

Dr. Lance M. Kaplan was born in Atlanta in 1967. He received the B.S. degree with distinction from Duke University, Durham, NC, in 1989 and the M.S. and Ph.D. degrees from the University of Southern California, Los Angeles, in 1991 and 1994, respectively, all in Electrical Engineering.

From 1987-1990, Dr. Kaplan worked as a Technical Assistant at the Georgia Tech Research Institute. He held a National Science Foundation Graduate Fellowship and a USC Dean's Merit Fellowship from 1990-1993, and worked as a Research Assistant in the Signal and Image Processing Institute at the University of Southern California from 1993-1994. Then, he worked on staff in the Reconnaissance Systems Department of the Hughes Aircraft Company from 1994-1996. Currently, he is an Assistant Professor of Engineering and is active in the Center for Theoretical Studies of Physical Systems (CTSPS) at Clark-Atlanta University, Atlanta.

His research interests include fractal analysis, modeling and synthesis, image processing, multiresolution analysis, synthetic aperture radar and automatic target recognition.

Postprocessing Images from Ultra-Wideband SAR

Professor James H. McClellan
Georgia Institute of Technology
ECE-DSP
Atlanta, Georgia
jim.mcclellan@ee.gatech.edu

Abstract

A new model for images formed in ultra-wideband (UWB) SAR represents the data collection and image formation steps as a 2-D filtering process. This result implies that simple postprocessing of selected image chips is equivalent to complex preprocessing of the raw data. Examples given will include the case where aspect dependent features are extracted from UWB SAR images received the B.S. degree in Electrical Engineering from

BRIEF BIO

James H. McClellan received the B.S. degree in Electrical Engineering from L.S.U. in 1969, and the M.S. and Ph.D. degrees from Rice University in 1972 and 1973, respectively. From 1973 to 1982, he was a member of the research staff at Lincoln Laboratory and then a professor at MIT. From 1982 to 1987, Dr. McClellan was employed by Schlumberger Well Services. Since 1987, he has been a Professor in the School of Electrical and Computer Engineering at Georgia Tech.

He is a co-author of the texts "Number Theory in Digital Signal Processing," "Computer Exercises for Signal Processing," and "DSP First: A Multimedia Approach." In 1996, Dr. McClellan received the Society Award from the IEEE Signal Processing Society, and in 1987, he received the Technical Achievement Award for work on FIR filter design. He is a Fellow of the IEEE and a member of Tau Beta Pi and Eta Kappa Nu.

Sensor Technology for Army After Next (AAN)

Mr. John Miller
Army Research Laboratory
jmiller@emh3.arl.mil

Abstract

The Army of the next century will rely heavily on information technology to provide near perfect knowledge of the future battlespace. Key to the ability to provide this unprecedented level of knowledge to the Army will be next generation sensor and processing technologies, particularly imaging sensors. Future battlefields will employ numerous sensors on a variety of platforms ranging from manned and unmanned aircraft, ground vehicles, remotely emplaced sensors, micro-robots, and smart munitions. Timely extraction and dissemination of critical information from these sensor data streams will require significant advances in image processing technology, particularly in image compression and target detection/recognition. This presentation will discuss notional sensor systems for the future Army, and the critical technologies necessary to achieve their envisioned capability, with particular emphasis on sensor fusion and image processing technologies.

Biographical Sketch
For Dr. Romain Murenzi

Dr. Romain Murenzi was born on February 28, 1959, in Save, Rwanda.

In June 1985 the Catholic University of Louvain, Belgium, awarded Mr. Murenzi a Fellowship to pursue his graduate studies. He obtained the Master's degree in Physics in June 1986 and the Ph.D. degree in Physics, in January 1990.

Dr. Romain Murenzi wrote his thesis under the supervision of Dr. Jean-Pierre Antoine and Dr. Alex Grossmann (the "Father of Wavelets" and Ph.D. mentor of Ingrid Daubechies, MacArthur Fellow). His thesis was related to the development and application of continuous multidimensional (with rotation) wavelets. As such, he is recognized internationally as the originator of this powerful technique for image processing, target detection and recognition.

Following his graduation, he was appointed as a Visiting Professor at the University of Paris VII (1990), followed by appointment to a research position within the European Center for Research and Advanced Training in Scientific Computation (CERFACS, Toulouse, France). He held this position from 1990 - 1992. From 1992 until the present, he has assumed the position of Associate Professor of Physics at Clark Atlanta University and senior researcher within the Center for Theoretical Studies of Physical Systems (CTSPS).

He is the co-director of the Image Processing group being formed within CTSPS and has successfully leveraged various important grants from the Office of Naval Research (ONR), the Advanced Research Projects Agency (ARPA), and the Ballistic Missile Defense Organization (BMDO), in the application of Continuous Multidimensional Wavelets (both stationary and time dependent) to coherent structure detection in fluids as well as ATR\&D (Automatic Target Recognition and Detection) for the military.

He has co-authored more than fifty papers, and has received numerous invitations at major conferences here and abroad. He is a Permanent Resident of the United States. Through his reputation, CTSPS has hosted important International Workshops in Wavelets involving the participation of some of the major researchers from the US. and Europe. Important collaborative linkages have been established with major U.S. wavelet research centers significantly impacting the scope of the ongoing research as well as enhancing the student research training efforts mandated by Clark Atlanta University's prominent Historically Black University heritage.

Feature Preserving Image Compression Techniques

Dr. Kameswara Namuduri / Dr. Romain Murenzi
Center for Theoretical Studies of Physical Systems
CIS Department/Department of Physics
Clark Atlanta University
Atlanta, Georgia
namuduri@hubble.cau.edu / murenzi@hubble.cau.edu

Abstract

Recent research has shown that wavelet based image compression techniques offer several advantages over traditional techniques in terms of compression ratio, image quality as well as computational time. Wavelet coefficients represent the information content in a given image. Image compression methods such as embedded zero-tree encoding and SPIHT rearrange the wavelet coefficients in the order of their significance and encode them. Such rearrangement facilitates progressive transmission and optimal bit allocation. In existing wavelet-based image compression techniques, the significance of a wavelet coefficient is solely defined by its magnitude. Although this definition is suitable for general image compression applications, it may not be suitable for specific applications such as Automatic Target Detection and Recognition.

In this presentation, we describe a method that provides flexibility in the selection of wavelet coefficients in the embedded zero tree encoding framework. This flexibility allows us to design compression techniques that preserve the features that we feel important for a specific application. It also allows us to improve the subjective image quality of the reconstructed image. The proposed technique is very simple to implement and it does not require any side (additional) information to be passed to the decoder.

A Template-based Technology for SAR ATR

Dr. Leslie M. Novak
MIT Lincoln Laboratory
lnovak@ll.mit.edu

Abstract

MIT Lincoln Laboratory is responsible for developing the ATR (automatic target recognition) system for the DARPA-sponsored SAIP program; the baseline ATR system recognizes 10 GOB (ground order of battle) targets; the enhanced version of SAIP requires the ATR system to recognize 20 GOB targets. This presentation compares the ATR performance results for 10- and 20-target MSE classifiers using high-resolution SAR (synthetic aperture radar) imagery.

BRIEF BIO

Leslie M. Novak is a senior staff member in the Surveillance Systems group, where he develops target-detection, acquisition, and classification algorithms for millimeter-wave synthetic-aperture radar systems. He is also studying polarimetric radar signal processing algorithms and superresolution signal processing algorithms. Les joined Lincoln Laboratory in 1977, after working from 1972 to 1977 at Raytheon Company, Bedford, Massachusetts, where he helped design the digital signal processor for the Patriot system and develop algorithms for Raytheon's pulse Doppler map-matching system. Before that, he developed extended Kalman tracking-filter algorithms for the TPQ-36 and TPQ-37 artillery and mortar-locating radar systems for Hughes Aircraft Company, Fullerton, California. From 1961 to 1968, he performed analytical studies of radar systems for Autonetics in Anaheim, California. He holds a B.S.E.E. degree from Fairleigh Dickinson University, an M.S.E.E. degree from the University of Southern California, and a Ph.D. degree in electrical engineering from the University of California, Los Angeles.

CIS Vision in Image Processing for Military Applications

Professor Joseph A. O'Sullivan
Center for Imaging Science
Department of Electrical Engineering
Washington University
St. Louis, MO
jao@ee.wustl.edu

Abstract

The Center for Imaging Science was founded in 1995 with a challenge to help define the fundamental theory of imaging and image understanding. The researchers in the center have taken this challenge seriously and have worked together, often across disciplinary lines and often across great distances, to make progress toward this goal. Currently, the five areas of emphasis in CIS research are:

1. Establishment of Fundamental Bounds and Metrics for Detection/Tracking/Identification
2. Multi-Sensor Fusion and Information Theory
3. The Infinity of Variation of FLIR/OPTICAL and Radar Signatures
4. Databases and Clutter: Collection, Characterization and Representation
5. Information Theory Based Complexity of Representation and Compression

Each of these goals will be reviewed briefly. Bounds on performance of detection and estimation algorithms in automatic target recognition problems have been obtained. These bounds will be reviewed in some detail, with emphasis on high resolution radar data (both HRR range profile data and MSTAR images). The framework that has been established for quantifying the increase in performance obtained by adding sensors will be described.

All of the efforts of the Center have a common underlying mathematical description in terms of scene models, sensor models, and inference based on sensor data. This mathematical description can be generalized to what is referred to as information-theoretic imaging. Information-theoretic imaging provides a rigorous framework for defining an imaging problem, for defining measures of optimality used to form estimates of images, for addressing issues associated with the development of algorithms based on these optimality criteria, and for quantifying the quality of the approximations.

BRIEF BIO

Professor Joseph A. O'Sullivan was born in St. Louis, MO, on January 7, 1960. He received the B.S., M.S., and Ph.D. all in Electrical Engineering from the University of Notre Dame in 1982, 1984, and 1986, respectively.

In 1986, he joined the faculty in the Department of Electrical Engineering at Washington University, where he is now an Associate Professor. In 1998, he was also appointed Associate Professor of Radiology. He was a founding member and recently became Director of the Electronic Systems and Signals Research Laboratory. He is a member of the Center for Imaging Science at Washington University. Prof. O'Sullivan was Secretary of the Faculty Senate, Secretary of the Senate Council, and Faculty Representative to the Board of Trustees at Washington University from 1995 to 1998.

He was the Publications Editor for the IEEE Transactions on Information Theory from 1992 to 1995, and is currently Associate Editor for Detection and Estimation. He has served on the organizing and program committees for several conferences and workshops. He is co-chair of the 1999 Information Theory Workshop on Detection, Estimation, Classification, and Imaging, and was in charge of travel grants and registration for the 1995 Information Theory Workshop on Information Theory, Multiple Access, and Queueing.

Prof. O'Sullivan is active in local IEEE activities as well. He has been the faculty advisor for the IEEE at Washington University for over ten years. He has held several officer positions in the St. Louis Section of the IEEE, including being chair of the section in 1994. He is a Senior Member of the IEEE, a member of Eta Kappa Nu, and a member of SPIE.

His research interests include information theory, estimation theory, and imaging science, with applications in object recognition, tomographic imaging, magnetic recording, radar, and formal languages. Current research projects include: modeling and performance analysis of target recognition, orientation estimation, and tracking using high resolution radar data; spiral CT imaging in the presence of known high density attenuators; physics-based capacity bounds for magnetic media; derivation and analysis of alternating minimization algorithms; information-theoretic analysis of steganography; and systems integration issues in magnetic information systems.

Visualization and Simulation in an Integrated Modeling and Testing Environment

Dr. Olugbemiga Olatidoye
Director, Visualization, Simulation and Design Laboratory (ViSiDeL)
Associate Professor, Department of Engineering
Clark Atlanta University
Atlanta, Georgia
tido@visidel.cau.edu

ABSTRACT

The power of visualization cannot be over emphasized. It allows us to form a mental image of our experiences and things not yet created. Image processing is an essential element of visualization, which concerns extracting useful information from a device that outputs in real time. The Visualization, Simulation and Design Laboratory (ViSiDeL) at Clark Atlanta University (CAU) is developing an Integrated Modeling and Testing (IMT) environment which involves modeling, analysis, visualization and simulation of complex engineering problems. The ViSiDeL facility has been aggressively pursuing the integration of Simulation, Design, and Visualization constructs, using a common visually based design interface resident on a object oriented framework.

Some of the analysis conducted to support virtual prototyping activities have extensively used high performance computing to solve complex real life problems, such as fluid-structure interactions on high rise buildings, ground vehicle response to local detonations, as well as visualization of missile trajectory. Advanced visualization and rendering tools are critical in all these areas to manage the vast amounts of scientific data collected as a part of the analysis, and to effectively extract the key trends within them. Within this environment there is always a need for recreation of models that are digitized from various mediums to vector images. For accuracy raster images are converted to vectorized images. For high fidelity model, there is always a need for high-resolution low-noise imagery and compression imagery for communications and storage. The focus of the talk will be to demonstrate some of the Visualization and modeling work in the simulated Integrated Modeling and Testing (IMT) environment at the ViSiDeL at CAU.

BIOSKETCH

Dr. Olugbemiga Olatidoye is the President of Tido Tech International (TTI). He is an Associate Professor of Engineering and the Director and founder of the Visualization, Simulation and Design Laboratory (A Virtual Reality Lab) at Clark Atlanta University (CAU). Other Centers directed by him at CAU include Atlanta Electronic Commerce Resource Center (AECRC), Army High Performance Computing Center (AHPCRC), DoD Major Shared Resource Center (MSRC), Army Research Laboratory (ARL), Army Corp of Engineer Waterways Experiment Station (CEWES) and Aeronautic System Center (ASC, Wright Patterson Air Force Base), all of which are Department of Defense (DoD) funded projects. He has serve as the Coordinator of the Dual Degree Engineering Program at CAU, which lead to the creation of the Engineering Department at CAU in 1994.

Dr. Olatidoye received his Bachelors degree in Architectural Engineering in areas of Structures from North Carolina A&T State University in 1982. He completed his Masters degree in Architecture at Virginia Polytechnic Institute and State University, another Master degree in Civil Engineering in Engineering Computer Graphics at Georgia Institute of Technology, located in Atlanta, Georgia. Other degrees from Georgia Tech are Knowledge Engineering and a Doctorate degree with emphasis on Intelligent Graphics. He is presently a member of the Board of Directors at Georgia Tech. He is a structural engineer by practice.

His research areas include Structural Dynamics, Visualization, Simulation and Design. He had chaired and presented at several notable conferences such as World Automation Congress Conference. Recently he was selected to serve on the proposal review panels for National Science Foundation (NSF) Interactive Graduate Education and Research Training (IGERT) program as a Lead reviewer, Writer, Reader and Scribe. Dr. Olatidoye has also provided service as a panel member on the Army Research Office (ARO) technical review panel.

A Space-Time Wavelet Transform Compiler System

Dr. Kenneth R. Perry
Computer and Information Science Department
Clark Atlanta University
Atlanta, Georgia
kperry@cau.edu

Abstract

This paper presents a design system for 'a priori space-time resource management of a dynamically configurable array of DSP RISC multiprocessors for real-time Wavelet transform computations. The design of the Wavelet-RISC Processor Algorithm Compiler System is based on the idea that some processing functions can be moved from hardware to software with the result that the simplified hardware can actually execute functions faster than with complicated hardware. This approach places a strong emphasis on the synergy between the hardware architecture and the software compiler. The DSP array architecture is tightly coupled to the software compiler resulting in an automated, optimizing, Wavelet transform algorithm compiler system. The Wavelet compiler provides the user with the ability to 'a priori select synthesis goals such as high-performance or low power, while providing a vendor–independent, high-yield, fault-tolerant architecture. The processor array can have configurable wordlength processing elements and the multiprocessor pipeline can be tuned to match I/O processing rates to provide for arrays of interconnected integrated circuits.

This paper presents a methodology for generating soft or hard macro Wavelet multiprocessors, each being a small, regular structure which can be tightly packed into an array, thus significantly increasing the gate utilization percentage of the gate array. The approach taken during the design of this system was first to consider the underlying communication geometry of the architecture. The ideal architecture for very large scale integration/wafer-scale integration is implemented as an array of simple regular structures of identical processing elements. Simple and regular structures lead to reliable, inexpensive implementations with high densities. High density implies both high performance and low overhead. This approach insures that the layout will be tight while reducing design and test development times.

The current status of this research will be presented. Software will be demonstrated showing macro- and micro-architectural level simulations. The micro-architecture of the multiprocessing elements have been implemented in hardware description languages and on a PC board.

BIO

Dr. Kenneth R. Perry is currently Chairman of the Computer and Information Sciences Department and Director of the Army Center of Excellence in Electronic Sensors/Combat at ***Clark Atlanta University***. He was awarded a BS degree in electrical engineering from Howard University, and MS and Ph.D. degrees in electrical engineering from Stanford University. At CAU he is currently serving as a Principal Investigator in the design of an Automatic Modulation Identification system incorporating wavelet transforms and neural networks, and a Neural Network Direction Finding Processor. He is Co- Principal Investigator in an ATM/ISDN Signaling Interface project, a Web-Based Interactive Trainer, and an on-Focal Plane Array Analog-to-Digital Converter. He has taught classes in computer architecture and organization; Very Large Scale Integration (VLSI) design; and microprocessor design and applications. He has developed interactive educational software for teaching computer architecture and organization using hardware description languages.

For ten years prior to joining CAU he served as President of MicroTech Industries. While at MicroTech he developed, licensed and sold products for the personal computer and telecommunications industries, specializing in digital signal processing and VLSI design. He was the chief architect in the design of the FlexChip. The FLEX paging protocol has been adopted in North America, Europe, China, Japan, Malaysia, Singapore and Thailand. He successfully designed or managed the design of over 30 projects including modem and personal computer chipsets, algorithms, and architectures for a spread spectrum receiver, full-duplex echo cancelers, sound and video compression-decompression, and cable and satellite modem receiver integrated circuits. He developed a programmable high-performance systolic digital signal processor, algorithm compiler software, and a neural network fetal heart rate analyzer. He has over 1 million integrated circuits currently in the field.

Prior to forming MicroTech, he worked at the ***Georgia Tech Research Institute*** where he developed signal processing algorithms for adaptive antenna arrays and cardiovascular monitoring and served as technical director in the design of the Military Standard 1750A 16-bit microprocessor. He also taught VLSI design, communications and linear systems . He is a member of Sigma Xi, Tau Beta Pi, The New York Academy of Sciences, and The Institute of Electrical and Electronic Engineers.

TESAR Automatic Target Recognition (ATR)

David L. Rodkey
US Army Research Laboratory
Chief, RF Image Processing Branch
Adelphi, MD
drodkey@mail.arl.mil

Abstract

A description of the Army's TESAR (Tactical Endurance SAR) synthetic aperture radar (SAR) system which was developed for the Predator Unmanned Aerial Vehicle (UAV) will be presented. A description of automatic target recognition algorithms developed under the Army STARLOS (SAR Target Recognition and Location System) program will also be given, along with recent performance results for a ground station based ATR system. This system will be demonstrated this fall for possible application in the Army's Tactical UAV program.

BRIEF BIO

David Rodkey is chief of the RF Image Processing Branch at the US Army Research Lab. He is responsible for programs conducting advanced research and exploratory development in the exploitation of Synthetic Aperture Radar (SAR) imagery for targeting and reconnaissance. In addition, he serves as the technical factor lead for Multi-Sensor Fusion Automatic Target Recognition (ATR) efforts in the Advanced Sensors Consortium of the ARL Federated Labs."

Image Based Target Classification Vision- Another Perspective

Firooz Sadjadi
Lockheed Martin Corporation
firooz.a.sadjadi@lmco.com

Abstract

Multi-Sensor Target classification is currently being envisioned to be used in a number of applications such as maritime airborne surveillance, next generation fighter aircraft, and unmanned aerial vehicles. The insertions of ATR technology for these platforms even though, sometimes is not viewed as a requirement by the Government, is nevertheless being seriously considered due to its future potential benefits. In this presentation a brief description of this vision will be given.

BRIEF BIO

Firooz Sadjadi - Received the BSEE from Purdue University in 1972, MSEE in 1974, and the Engineer Degree in EE in 1976 from the University of Southern California (USC). He performed postgraduate studies for PhD at USC and the University of Tennessee, Knoxville. He worked at the USC Image Processing Institute and the Image and Pattern Analysis Laboratory of the University of Tennessee, and was a consultant to the Oak Ridge National Laboratory. During 1983-1993 he was with the Honeywell Systems and Research Center as a principal research scientist. In 1993 he joined the Lockheed Martin Corporation as a staff scientist.

His interest are in signal and image processing technology areas such as automatic target recognition, image exploitation systems and information fusion. He is the organizer of the International Conference on Automatic Target Recognition that he has chaired for the past nine years. He was the Guest Editor for the Optical Engineering Journal Special Issues on" Performance Evaluations of Signal and Image Processing Systems," February 1991, and "Automatic Target Recognition," December 1992, and the July 1997 Special Section of IEEE Computer on "Applications of Computer Vision". He is the author of more than 100 publications, and holds six patents. He is the editor or author of several books including Sensor and Data Fusion, 1996, Performance Evaluations of Signal and Image Processing Systems, 1993, (both by SPIE Press), and a forthcoming book on Automatic Target Recognition Systems. He is a Senior Member of IEEE, and is a member of Sigma Xi and SPIE.

He has received a number of technical awards among them the Honeywell Technical Achievement Award.

How Image Processing Contributes to the Future Vision of BMDO and the Air Force

Lt. Col. Steven C. Suddarth
Air War College
ssuddarth@sprynet.com

Abstract

Our defense establishment has a vision for how we should enter into the next millennium which depends greatly on enhanced image processing, recognition, and interpretation capabilities. The imagery will cover all bands and types, such as visible, IR, UV, LIDAR, SAR, multispectral and hyperspectral. This talk will briefly cover some of the application areas and architectures, focused particularly on ballistic missile defense, counterproliferation, and cruise missile defense. Significant technology challenges required to provide these types of processing, and some potential advances will be discussed.

DARPA Sensor Exploitation Vision

Mr. Stephen Welby
Defense Advanced Research Projects Agency
(DARPA/ISO)
swelby@darpa.mil

Abstract

The DOD's "Joint Vision 2010" serves as the capstone guidance for the evolution of US warfighting capabilities. This document identifies "Dominant Battlespace Awareness" as a critical technological opportunity to insure future battlefield supremacy for US forces. The Defense Advanced Research Project Agency is pursuing a number of research and development activities, both short and long term, to make this concept of dominant battlespace awareness an operational reality.

Ongoing development programs in the DARPA Information Systems Office will permit commanders to better leverage the flood of pixels produced by the current and next generation of military imaging sensors. These programs include the Semi-Automated IMINT Processing ACTD, a near-term demonstration program which seeks to provide automated tools to increase the throughput of operational imagery analysts; the Automated Video Surveillance (AVS) program, which is developing innovative tools for the exploitation of video streams from manned and unmanned airborne systems; the MSTAR program, which is working to advance the state of the art in model based target recognition; and the Dynamic Database program, which seeks to provide new mechanisms to exploit large georeferenced, multi-sensor databases.

This talk will provide an overview of these and other DARPA efforts focused on making imagery a more timely and capable asset to the warfighter.

BRIEF BIO

Mr. Stephen Welby serves as Program Manager for the Semi-Automated IMINT Processing (SAIP) program for the Defense Advanced Research Projects Agency (DARPA). The SAIP Advanced Concept Technology Demonstration (ACTD) is focused on demonstrating an integrated suite of tools derived from DARPA sponsored image understanding (IU) and automatic target recognition (ATR) research. The SAIP ACTD applies these technologies to the rapid, machine-assisted generation of operational intelligence from reconnaissance and surveillance imagery.

Prior to coming to DARPA, Mr. Welby was team leader for the Synthetic Aperture Radar Target Recognition and Location System (STARLOS) at the US Army Research Laboratory (ARL). STARLOS and its predecessor efforts focused on supporting ATR-based real-time targeting from airborne imaging radars, such as the synthetic aperture radar (SAR) deployed on the PREDATOR unmanned air vehicle. Mr. Welby also supported the Intelligent Bandwidth Compression (IBC) program at ARL and served as principle investigator for the ARL advanced sensors consortium research in SAR ATR.

Mr. Welby received a BS in Chemical Engineering from The Cooper Union for the Advancement of Science and Art, Manhattan NY (1987), an MS in Business Administration from Texas A&M University, Texarkana TX (1988), an MS in Applied Mathematics from The Johns Hopkins University, Baltimore MD (1991) and an MS in Computer Science from The Johns Hopkins University (1996).

BMDO OPPORTUNITIES

Mrs. Carol Williams
Ballistic Missile Defense Organization (BMDO)
Science and Technology Directorate (TOR)
Carol.Williams@bmdo.osd.mil

Abstract

(UNAVAILABLE)

BIO

Mrs. Carol Williams is a Program Analyst for the Ballistic Missile Defense Organization (BMDO) responsible for all budget and financial transactions for the Innovative Science and Technology (IS&T), Small Business Innovation Research (SBIR), Technology Applications (TA), and Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) programs. For the last program she has technical responsibility and coordinates with the BMDO Small & Disadvantage Business Office. She is also responsible for maintaining a close liaison with the BMDO Small and Disadvantaged Business Utilization Directorate. In this capacity, Mrs. Williams established a model HBCU program and continues to correspond with various universities to facilitate and coordinate more minority participation in BMDO funded research.

Prior to this appointment Mrs. Williams served as a Program Analyst in the BMDO Civil Applications and Technology Applications office, where she was responsible for the financial transactions of an annual budget of 60M.

Mrs. Williams earned her Bachelor of Science degree in Business Management from the University of Maryland in 1988. She has been with the Ballistic Missile Defense Organization since March of 1986.

Image Processing Approaches From a Model-based Perspective

Mr. Ed Zelnio
Wright Laboratory
ezelnio@mbvlab.wpafb.af.mil

Abstract

Many image processing algorithms look at images as two dimensional signals or x-y intensity arrays. A model-based perspective to image processing suggests that images be treated as projections or slices of the 4D world. Images, therefore, are considered as time slices, geometrical projections, and physical transformations of the real world. This perspective to image processing opens a number of opportunities for significant advancement in important applications. Model-based ATR is used as an example to illustrate the types of image processing approaches that take advantage of this perspective. Model-based ATR is decomposed into its constituent elements and image-processing techniques are exemplified for each of these elements. An important advancement from the model-based approaches is the change of ATR problem definition. It changes from 1) recognizing targets in a given set of x-y intensity arrays or images representative of the ATR problem to 2) an ATR problem defined in terms of the parametric variation of physical, geometrical, and time real world descriptors. This advance is significant given the immense complexity of the real world and the practical resource limitation of ever being able to collect enough measured data to represent the real world variability.